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THE VERTEBRATE FAUNA OF THE UPPER TRIASSIC (REVUELTIAN) SNYDER QUARRY

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Abstract—Since the first scientific excavations, it has been apparent that the Snyder quarry represents a unique vertebrate fossil assemblage. This assemblage includes an apparent xenacanthid shark, semionotid and redfieldiid fish, a metoposaurid amphibian, a probable procolophonid reptile, a cynodont, an apparent lepidosauromorph, abundant specimens of the phytosaur *Pseudopalatus*, the aetosaurs *Typothorax coccinarum* Cope and *Desmatosuchus chamaensis* Zeigler, Heckert and Lucas, the rauisuchian *Postosuchus* (*sensu stricto*), a sphenosuchian and theropod dinosaurs referable to *Eucoelophysis*. Archosaurs dominate the assemblage, and the phytosaurs, and aetosaurs are all treated separately elsewhere in this volume. The xenacanth apparently pertains to the "*Xenacanthus*" *moorei* group and, if it is not a contaminant from screenwashing processes, is one of the youngest xenacanth sharks known. Most osteichthyan fossils at the Snyder quarry are isolated scales and bones, though an incomplete, articulated semionotid has been recovered. The sole metoposaurid fossils recovered to date are a fragmentary, large centrum and isolated teeth that probably pertain to *Buettneria* and would thus be one of the youngest *Buettneria* records known. The possible procolophonid fossil consists of a single tooth and remains problematic. The cynodont is represented by an incomplete left distal humerus. The lepidosauromorph is based on an incomplete jaw fragment bearing many pleurodont teeth. The archosaur fauna is somewhat typical of Revueltian Chinle faunas in that it includes the phytosaur *Pseudopalatus* and the aetosaur *Typothorax coccinarum*, both index taxa of the Revueltian (early-mid Norian) land-vertebrate faunachron. Rarer archosaurian taxa include the aetosaur *Desmatosuchus chamaensis*, the theropod dinosaurs, the rauisuchian *Postosuchus* and the indeterminant sphenosuchian. The rauisuchian is represented by fragmentary postcrania that, from their disparate sizes, clearly represent at least two different individuals.

Keywords: procolophonid, cynodont, rauisuchian, xenacanth, semionotid, lepidosauromorph, Upper Triassic

INTRODUCTION

The Snyder quarry (NMMNH locality 3845) is an exceptionally rich bonebed in the Petrified Forest Formation of north-central New Mexico (Fig. 1). Shortly after scientific excavations at the Snyder quarry began in 1998, it was apparent that the quarry preserved a diverse vertebrate fauna. Clearly, the vast majority of the preserved bones pertained to reptiles, principally archosaurs, but many other vertebrate groups were preserved as well. We have highlighted the diversity of vertebrates from the Snyder quarry in both abstracts (Heckert et al., 1999a,b) and referred to it in preliminary papers (Heckert et al., 2000; Zeigler et al., 2002a,b,c). This paper, however, is the first illustrated documentation of much of the vertebrate fauna. Accordingly, we aim to document the rarer and less-well preserved taxa from the Snyder quarry here. Other papers in this volume highlight the phytosaurs (Zeigler et al., 2003a,b) and the aetosaurs (Heckert et al., 2003a). Most of the fauna we describe here was recovered by traditional vertebrate excavation techniques. However, many of the microvertebrates we describe here were recovered from screenwashing. Most of the matrix we have screenwashed and picked thus far came directly from jackets that were prepared at NMMNH, although we also collected matrix from the main bone horizon in the field, principally as a byproduct of trenching to make additional jackets. Most screenwashing was carried out with flat screens (1/4 inch, 1/8 inch, window screen, and ~30 mesh) stacked on top of each other.

In general, we feel that the Snyder quarry fauna is diverse because it represents a catastrophic assemblage and thus, taphonomically, can be expected to preserve more of a "snapshot" of the vertebrate community than might an attritional assemblage (Zeigler, 2002, 2003). However, we also think that we have been particularly careful to document any and all vertebrate fossils we have encountered, and thus have been able to correct for some of the "collector's bias" evident in Chinle sites worked previously, especially those discovered in the first half of the twentieth century. The discovery of the Snyder quarry is documented elsewhere in this volume (Heckert and Zeigler, 2003).

Throughout this paper, NMMNH refers to the New Mexico Museum of Natural History and Science, Albuquerque.

STRATIGRAPHY AND AGE

The Snyder quarry is stratigraphically high in the Painted Desert Member of the Petrified Forest Formation, approximately 30 m below the contact with the overlying Rock Point Formation (Fig. 1). This stratigraphic position is essentially equivalent to that of the nearby Canjilon quarry, 3 km to the east (Lucas and Hunt, 1992; Hunt and Lucas, 1993a; Zeigler, 2002; Lucas et al., 2003). Biostratigraphically significant taxa from the Snyder quarry include the phytosaur *Pseudopalatus* and the aetosaur *Typothorax coccinarum*, both index taxa of the Revueltian (early-mid Norian) land-vertebrate faunachron of Lucas and Hunt (1993; Lucas, 1998). Cross-correlation of Lucas' (1998) tetrapod-based Triassic timescale with recent published Late Triassic numerical timescales (e.g., Kent et al., 1995; Kent and Olsen, 1999, 2000) suggests that Revueltian time spanned approximately 218 to 208 Ma. The Snyder quarry is relatively high in the Painted Desert Member, and therefore is probably in the latter half of that time interval, although thus far no reliable numerical dates have been obtained from Chinle strata in the Chama basin.

Numerous Revueltian faunas are known from Chinle strata in Texas, New Mexico, and Arizona (Lucas and Hunt, 1993; Hunt and Lucas, 1993b; Long and Murry, 1995; Hunt, 2001). Revueltian faunas from Arizona include those from the Painted Desert Member in Petrified Forest National Park and vicinity (Long and Murry, 1995; Hunt and Lucas, 1995; Heckert and Lucas, 2002) and the Owl Rock Formation (Kirby, 1989, 1990, 1991, 1993). New Mexican Revueltian faunas include the fauna of the Bull Canyon Formation in east-central New Mexico

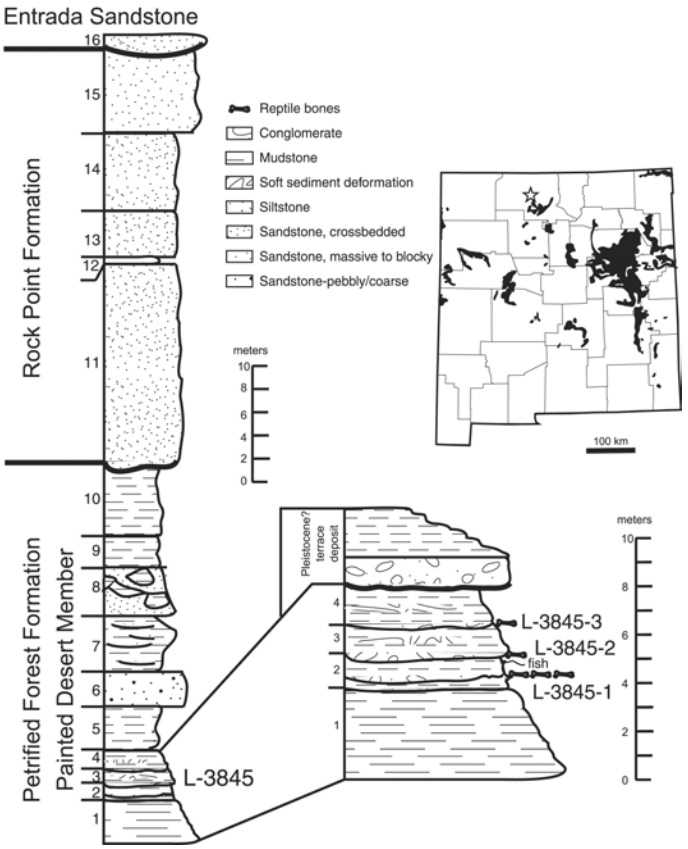

FIGURE 1. Index map showing location of the Snyder quarry site in north-central New Mexico, distribution of Triassic outcrops (from Heckert et al., 2000), and stratigraphic section at the quarry.

(Hunt and Lucas, 1993b; Hunt, 1994, 2001) and other faunas from the Chama basin (Lucas and Hunt, 1992; Hunt and Lucas, 1993a; Lucas et al., 2002). The most important Revueltian fauna in West Texas, also from the Bull Canyon Formation, is that of the Post quarry (Long and Murry, 1995). The Bull Canyon Formation and the Painted Desert Member of the Petrified Forest Formation are homotaxial (Lucas, 1993, 1997), so the fact that both yield a remarkably similar tetrapod assemblage is hardly surprising. Most Revueltian faunas come from low in the Bull Canyon Formation or Painted Desert Member of the Petrified Forest Formation, so, based on lithostratigraphic position, the Snyder quarry should be somewhat younger than almost all of these faunas. This is particularly true of the type Revueltian fauna from Revuelto Creek, which is from very low in the Bull Canyon Formation (Lucas and Hunt, 1993; Hunt, 2001; Lucas et al., 2001). Indeed, the only Revueltian faunas as stratigraphically high or higher than the Snyder quarry are the other Chama basin faunas, specifically the Canjilon and Hayden quarries (Hunt and Lucas, 1993a; Hunt and Downs, 2002; Zeigler, 2002; Lucas et al., 2003), and Kirby's (1989, 1991, 1993) Owl Rock Formation faunas in Arizona. The latter are presumably younger than the Snyder quarry, as the Owl Rock Formation, wherever it occurs, overlies the Painted Desert Member. However, there are no Owl Rock Formation strata in north-central New Mexico, so it is possible, albeit we think unlikely, that upper Painted Desert Member strata in the Chama basin are laterally equivalent to Owl Rock Formation strata elsewhere.

Hunt (2001) subdivided Revueltian time into three intervals, his Rainbowforestan, Barrancan, and Lucianoan sub-faunachrons. While we believe this attempt is laudable, and even agree with his stratigraphic interpretations, we have previously noted problems with this scheme (Heckert and Lucas, 2002). Specifically, we disagree with his use of "*Nicrosaurus*" to define the Rainbowforestan, as we consider North American "*Nicrosaurus*" to pertain to *Pseudopalatus* (Lucas et al., 2002; Zeigler et al., 2002a). This makes it impossible for us to distinguish his Rainbowforestan from his Barrancan, the latter essentially encompassing the original type Revueltian fauna of Lucas and Hunt (1993). If Revueltian time is subdivisable using tetrapods, then, logically, the Snyder quarry fauna should pertain to Hunt's (2001) youngest subfaunachron, the Lucianoan. The Lucianoan is based on the vertebrate fauna of the upper Bull Canyon Formation near Luciano Mesa, and the primary index taxon is the ornithischian dinosaur *Lucianosaurus* (Hunt, 2001). However, *Lucianosaurus* is known only from the type locality (Hunt and Lucas, 1994; Hunt, 2001), and thus cannot yet be used for correlation. Accordingly, at this time we can not yet implement any of Hunt's (2001) proposed biozonation, and thus can only refer to the Snyder quarry fauna as Revueltian, presumably younger Revueltian, and thus probably approximately 208-214 Ma by present time scales.

SYSTEMATIC PALEONTOLOGY

CHONDRICHTHYES Huxley, 1880

ELASMOBRANCHII Bonaparte, 1838

XENACANTHIFORMES Berg, 1955

XENACANTHIDAE Fritsch, 1889

"*Xenacanthus*" Beyrich, 1848

"*Xenacanthus*" *moorei* (Woodward, 1889)

The only chondrichthyan fossil recovered from the Snyder quarry is an incomplete tooth of a xenacanth shark (NMMNH P-33112) (Fig. 2). This tooth is undoubtedly a xenacanth, and possesses the triangular to subovoid (teardrop-shaped) base with anterior (distal) and posterior (mesial) cusps and a smaller, central cusp, all aligned along the labial edge of the tooth. This morphology is typical of xenacanth teeth found in the Chinle Group (Johnson, 1980; Murry, 1982, 1986; Heckert, 2001). Schneider (1988, 1996) argued forcefully and convincingly that the name *"Xenacanthus"* should not be used for Triassic xenacanths, but failed to determine the first valid generic name that applies to Triassic xenacanths. This leaves the taxonomy of the Triassic xenacanths unresolved. The principal problem is that Triassic xenacanths are generically distinct from Paleozoic xenacanths, including *Xenacanthus* itself (Schneider, 1996). However, the only other genus name used to describe them is *Pleuracanthus*, which is itself based on a skeleton with poorly preserved teeth that have never been illustrated (Johnson, 1980). Therefore, we use "*Xenacanthus*" when discussing teeth that obviously pertain to the "-*moorei* group" of Schneider (1996).

Thus, this tooth clearly pertains to *"Xenacanthus" moorei* as typically used for Chinle specimens (Murry, 1982, 1986, 1989a,b). However, xenacanths are unknown in Revueltian rocks in the Chinle (Huber et al., 1993; Murry and Kirby, 2002), and a singleton specimen such as this is thus difficult to base a significant range extension on, especially because it may be a contaminant from another, Carnian locality retained in the screens we used to screenwash Snyder quarry vertebrates. This scenario is possible because, prior to washing the Snyder quarry matrix, these screens were previously used to wash diverse Carnian sites, including several that yielded abundant specimens of "*Xenacanthus*" (Heckert, 2001).

OSTEICHTHYES Huxley, 1880

Osteichthyes indet.

Diverse fossils from the Snyder quarry pertain to indeterminate osteichthyans. Among these are a centrum (NMMNH P-31652) that is round and hollow in the center. The ventral side is somewhat flattened, with two grooves separated by a ridge running anteroposteriorly. It is concave both anteriorly and posteriorly.

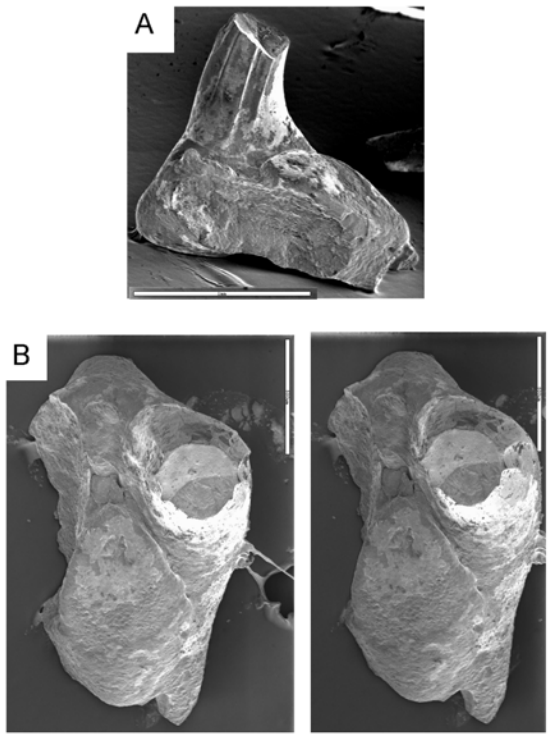

FIGURE 2. Scanning electron microphotograph of NMMNH P-33112, a xenacanth tooth fragment from the Snyder quarry. Scale bar = 1 mm.

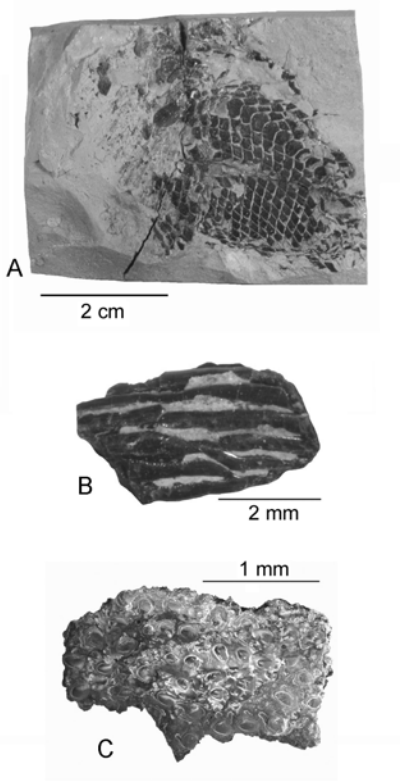

FIGURE 3. Osteichthyan fossils from the Snyder quarry. **A,** NMMNH P-29043, a semionotid body fossil, **B,** NMMNH P-35968, a redfieldiid skull element. **C,** NMMNH, uncatalogued, a coelacanth(?) tooth plate.

OSTEICHTHYES Huxley, 1880

HALECOSTOMI Regan, 1923

SEMIONOTIFORMES Arambourg and Bertin, 1958

SEMIONOTIDAE Woodward, 1890

Semionotidae indet.

An incomplete body (NMMNH P-29043) (Fig. 3A) is approximately 75% of a complete fish that is missing the head. Overall, the specimen is 51 mm anteroposteriorly and 33 mm dorsoventrally. There are no noticeable fins or spines, though the specimen has been slightly disarticulated. Towards the dorsal end, the ganoid scales become wider, longer and semi-lunate in shape. All other scales are diamond-shaped, with no apparent ornamentation. There is a single large, ovoid scale towards the anterior end that may represent a gill cover. A lateral line is barely noticeable near the dorsal edge of the specimen.

ACTINOPTERYGII Klein, 1885

REDFIELDIFORMES Berg, 1940

REDFIELDIIDAE Berg, 1940

Redfieldiidae indet.

Skull fragments (NMMNH P-35968, P-31655 and P-36065) (Fig. 3B) are incomplete plates with longitudinal grooves and ridges. They are generally ovoid in outline and are less than 5 mm in any dimension. We assign these fragments to Redfieldiidae because of the pattern of subparallel ridges and grooves on the surface of the plates (Schaeffer, 1967). The dentary or dermal plate (NMMNH P-33113) is an approximately 2 mm-square plate with a random pattern of raised bumps across its surface.

SARCOPTERYGII Romer, 1955

COELACANTHIDAE Berg, 1937

Coelacanthidae indet.

Screenwashing of Snyder quarry matrix has yielded a single fragmentary tooth plate of a possible coelacanthid. This xiphidont fragment, NMMNH, uncatalogued, possesses numerous small, low, bulbous, blunt teeth (Fig. 3C). Traditionally, toothplates such as these from the Chinle Group have been referred to either the Colobodontidae or Perleididae (e.g., Murry, 1982, 1986, 1989a, b; Huber et al., 1993; Heckert, 2001). However, R. Mutter (pers. comm.) assures us that these are not colobodontids (see also Mutter, 2002). These toothplates are also superficially similar to those of some coelacanths and, given that colobodontid scales are not known from the Chinle, but coelacanthid skulls and scales are not uncommon (Huber et al., 1993), we tentatively assign them to the Coelacanthidae? indet.

AMPHIBIA Linnaeus, 1758

LABYRINTHODONTIA von Meyer, 1842

TEMNOSPONDYLI Zittel, 1887-1890

METOPOSAURIDAE Watson, 1919

***?Buettneria* Case, 1922**

Metoposaurid temnospondyls are represented by a single vertebral centrum (NMMNH P-29989), two labyrinthodont teeth (NMMNH P-29169 and P-33114) and an incomplete chevron (NMMNH P-31653). The centrum is 28 mm dorsoventrally, 32 mm wide and 24 mm anteroposteriorly (Fig. 4). It is in relatively poor condition and has no processes preserved. The specimen is solid, very short and shaped like a wide spool. The outline of the centrum is a rounded square. The anterior and posterior margins dip down into the center of the body, giving it a moderately constricted appearance. The ventral side has a central groove that is deep and narrow, with smaller, shallower grooves and ridges radiating laterally on either side. We refer this specimen to the Metoposauridae because the centrum is fully ossified (hypocentrum) with no room for a pleurocentrum, and is short in length (Romer, 1947;

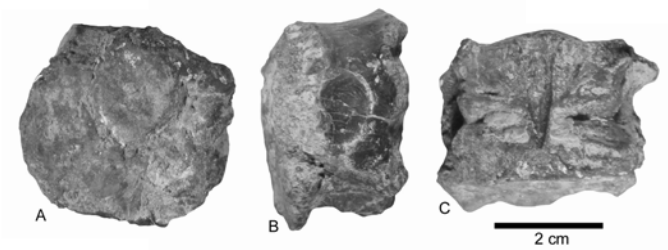

FIGURE 4. NMMNH P-29989, a metoposaur centrum from the Snyder quarry in **A,** anterior?, **B,** dorsal and **C,** ventral views.

Hunt, 1994; Long and Murry, 1995). This centrum is much larger than any known centrum of *Apachesaurus*. It is also proportionately shorter antero-posteriorly and relatively tall. We therefore tentatively refer it to *Buettneria* sp. Regardless of its generic assignment, this is one of the youngest records of a large metoposaurid, as *Buettneria* is exceptionally rare in Revueltian rocks (Hunt, 1993; Hunt and Lucas, 1993).

The teeth display the crenulated or infolded enamel pattern common to labyrinthodonts, though the crenulation on these teeth is very fine. They are gently recurved lingually, with a moderate lingual bulge towards the base of the tooth. NMMNH P-29169 is 15 mm from base to tip, and NMMNH P-33114 is 10 mm tall.

An incomplete chevron (NMMNH P-31653) has also been recovered that may be referable to a metoposaurid amphibian. This specimen consists of half of the proximal end of the chevron and is 9 mm dorsoventrally, 7 mm anteroposteriorly and 5 mm wide on the articular facet. It is a y-shaped articular branch that is part of the pair found on complete chevrons. The proximal articular facet dips medially and is round in outline. The lateral edge is flat and relatively broad and angles medially. The medial edge is overhung dorsally by the articular facet, and this side of the bone is broad and flat and also medially angled.

PARAREPTILIA Olson, 1947

PROCOLOPHONIDAE Seeley, 1888

Procolophonidae indet.

A procolophonid is represented by a single premaxillary tooth (NMMNH P-36067) that is button-shaped (Fig. 5). This tooth is round in cross-section, very slightly recurved, with a blunt occlusal surface and a moderate lingual bulge. There are faint striations and possibly a wear facet on the tip on the lingual side. We refer this specimen to Procolophonidae due to the button-like appearance of the tooth, the round cross-section and the faint wear-facet on the lingual margin (Colbert, 1946; Sues et al., 2000).

SYNAPSIDA Osborn, 1903

CYNODONTIA Owen, 1861

Tritylodontidae? indet.

A single specimen is referable to Cynodontia, possibly to Tritylodontidae. This small, gracile, left distal humerus (NMMNH P-29044) measures 15 mm from midshaft to the distal end, 13 mm mediolaterally across the distal head, 4 mm mediolaterally at midshaft, 3 mm dorsoventrally at midshaft, 1 mm dorsoventrally on the entepicondylar flange and 4 mm dorsoventrally on the capitellum (Fig. 6). The shaft is approximately circular in outline and has very thin walls. The interior has been filled with crystalline matrix. The shaft flares out abruptly into the distal end of the humerus, which has two flanges, one projecting laterally (the ectepicondyle) and one medially (the entepicondyle). The capitellum is strongly developed and is present on both the dorsal and ventral aspects of the specimen, but is less developed on the dorsal side. The trochlea is moderately well developed and is strongly convex. It is strongest in dorsal aspect, with a very weak presence on the ventral side. The entepicondyle is a round, very thin flange that projects medially and somewhat distally. It is concave on the dorsal side, and there is a very

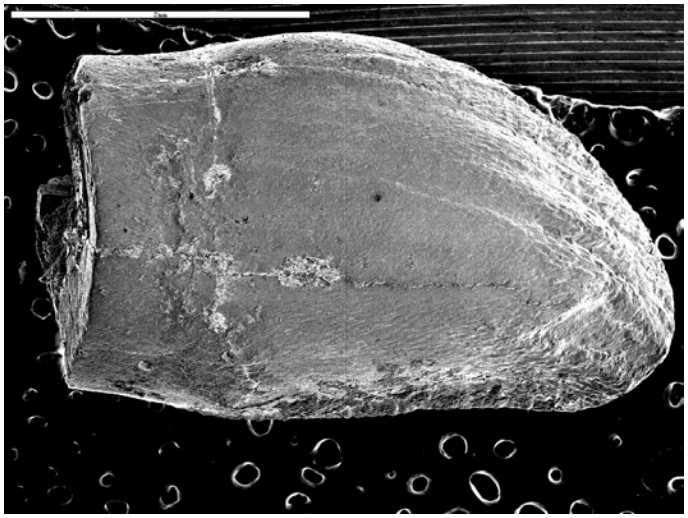

FIGURE 5. Scanning electron microphotograph of NMMNH P-36067, a procolophonid premaxillary tooth from the Snyder quarry. Scale = 2 mm.

small, round entepicondylar foramen present proximal and medial to the capitellum that is wider on the dorsal surface than it is on the ventral surface. The ectepicondyle, a thin flange extending distally past the trochlea, is broken at the ectepicondylar foramen so that the proximal edge of the foramen is preserved.

This distal humerus looks strikingly similar to the illustrated humerus of the tritylodont *Oligokypus* (Kuhne, 1956) (Fig. 7), though the capitellum is slightly more developed in the Snyder quarry specimen. Given the similarities between the two specimens, it is unlikely that much of the ectepicondyle of the Snyder quarry specimen is mis-sing. The Snyder quarry humerus is moderately similar to *Bienotherium* (Young, 1947), though the capitellum in *Bienotherium* is much less developed than in the Snyder specimen, and the entepicondylar bridge is very pronounced in *Bienotherium*, while it is not developed in NMMNH P-29044. This specimen is not at all similar to the traversodontid *Exaeretodon* (Bonaparte, 1963), in which the capitellum and trochlea are poorly developed, the shaft is neither long nor cylindrical and has only a very brief constriction before flaring out into the proximal head, there is no ectepicondylar foramen present and the entepicondylar foramen is very strongly developed when compared to the Snyder quarry specimen.

The very strong resemblance of this specimen to the illustrated humerus of the tritylodont *Oligokypus* may justify assigning this specimen to the Tritylodontidae. However, the oldest unambiguous tritylodonts are from the Early Jurassic (Lucas and Hunt, 1994). Thus, if this specimen can be definitively referred to Tritylodontidae, then this marks the oldest occurrence of the tritylodonts and extends their age range by nearly 15 million years. Bonaparte (1978) described an incomplete humerus from the Upper Triassic Los Colorados Formation of Argentina that he referred to Tritylodontidae (Fig. 8). However, this specimen, also a distal humerus, does not compare favorably with other illustrated tritylodont specimens, especially that of *Oligokypus*. The ectepicondyle is not developed in the Los Colorados specimen, and there is no evidence of an ectepicondylar foramen. Also, the shaft is quite broad, and does not immediately constrict as does the shaft in *Oligokypus*. One similarity is that the entepicondylar foramen is quite large, with a well developed bridge over it. As the Los Colorados distal humerus does not appear similar to illustrated tritylodontid specimens, we note that this is probably not a tritylodontid humerus, as did Lucas and Hunt (1994).

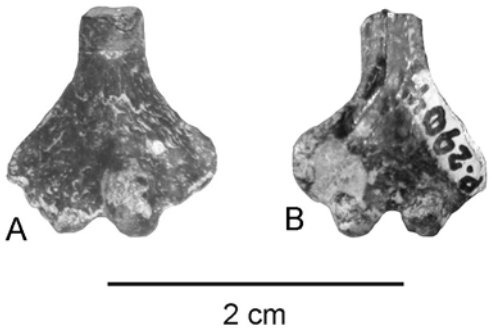

FIGURE 6. NMMNH P-29044, a cynodont left distal humerus from the Snyder quarry.

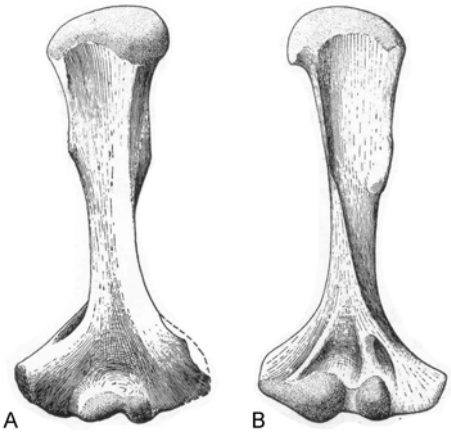

FIGURE 7. An illustration of the right humerus (x2) of the tritylodont *Oligokyphus* from Kühne (1956). Left figure is dorsal view, right figure is ventral view. U = ulnar articulation, R = radial articulation.

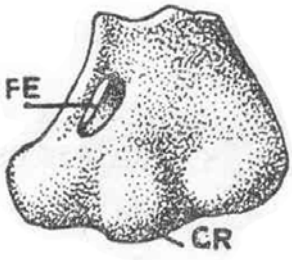

FIGURE 8. An illustration of an indeterminate "tritylodont" from the Los Colorados Formation of Argentina (from Bonaparte, 1978). FE denotes position of entepicondylar foramen. CR denotes position of capitellum.

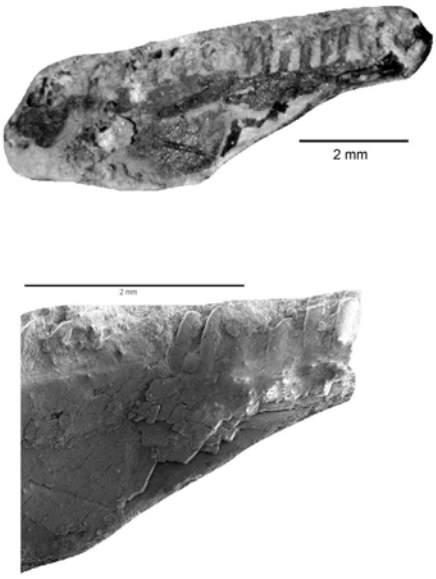

FIGURE 9. NMMNH P-35974, a lepidosauromorph jaw fragment from the Snyder quarry as viewed through **A,** standard binocular microscope and **B,** scanning electron microscope.

DIAPSIDA Osborn, 1903

LEPIDOSAUROMORPHA Benton, 1983

Lepidosauria indet.

A single lepidosauromorph specimen is a very small jaw fragment encased in a block of matrix (NMMNH P-35974) (Fig. 9). To the naked eye, the jaw is a long, thin rod with tiny pegs along the dorsal surface, giving it a comb-like appearance (Fig. 9A). Viewed with a scanning electron microscope, a few more details are evident (Fig. 9B). The teeth are slender and cylindrical (peg-like), with a slight recurvature and are moderately closely spaced in the jaw. The teeth towards the anterior end of the jaw are more widely spaced and more recurved than those towards the posterior end. There are 16 preserved teeth present in this jaw fragment, and the bone itself is fragmentary. There are no apparent external fenestrae in the jaw bone itself, which is long and slender, with a convex ventral border. We refer this specimen to Lepidosauromorpha indet. due to the pleurodont implantation, simple, cylindrical teeth that are somewhat recurved and isodont and to the shape of the jaw bone, which is long and slender and ventrally convex (Romer, 1947).

ARCHOSAURIA Cope, 1869

CROCODYLOTARSI Benton and Clark, 1988

PARASUCHIDAE Lydekker, 1888

***Pseudopalatus* Mehl, 1928**

***Pseudopalatus buceros* (Cope, 1881)**

Phytosaur material recovered from the Snyder quarry is composed of both cranial and postcranial material. Eleven skulls have been recovered along with several dozen associated or isolated postcranial elements. The skulls all pertain to *Pseudopalatus* based upon the following characteristics (Long and Murry, 1995): the squamosals have a posterior process that is prolonged, are narrow dorsoventrally and taper to a sharp point. The rostrum is slender and very long, so that the rostral length is much greater than that of the posterior portion of the skull. The teeth of *Pseudopalatus* are homodont to weakly heterodont, with well separated alveoli. The parietal-occipital complex is an inverted "u" in outline, as seen in the posterior view. The nares are raised above the level of the skull deck (though this may be a taphonomic feature more than a

morphological feature). The supratemporal fenestrae are narrow and recessed below the skull deck, and the parietal wings are depressed and concealed in dorsal view. We describe the phytosaur cranial and postcranial material separately in this volume (Zeigler et al., 2003a,b).

ARCHOSAURIA Cope, 1869

AETOSAURIA Nicholson and Lydekker, 1889

STAGONOLEPIDIDAE Lydekker, 1887

***Typothorax* Cope, 1875**

***Typothorax coccinarum* Cope, 1875**

The armored herbivorous archosaur *Typothorax coccinarum* is one of the most common tetrapod fossils in upper Chinle Group strata and was one of the first Late Triassic tetrapods to be described from the American Southwest (Cope, 1875; Lucas and Hunt, 1992; Heckert and Lucas, 2002; Lucas et al., 2002). The dorsal paramedian osteoderms (scutes) of *T. coccinarum* are diagnosed by the dense pattern of subcircular pits that cover the dorsal surface of the scute, the presence of a strongly developed anterior bar, the presence of a strongly developed ventral keel, dorsal paramedian scutes that are generally four times wider than long, and lateral scutes with an acute angle of flexure. Scutes and other postcranial fossils from the Snyder quarry that pertain to *T. coccinarum* are described separately in this volume (Heckert et al., 2003).

***Desmatosuchus* (Cope, 1892)**

***Desmatosuchus chamaensis* Zeigler, Heckert and Lucas, 2002**

Scutes of the aetosaur *Desmatosuchus* that have been recovered from the Snyder quarry pertain to a distinct species, *Desmatosuchus chamaensis* (Zeigler et al., 2002b). Indeed, the Snyder quarry is the type locality of *D. chamaensis*, which is known only from one other locality at this time (Zeigler et al., 2002b). These scutes are diagnosed from the older species, *D. haplocerus*, by the presence of long, recurved spikes on the dorsal scutes, noncervical lateral scutes with small, pyramidal spikes, a pattern of ridges and grooves radiating from the spike or boss in the scute's center and the presence of a moderately developed anterior bar. These scutes lack the strong ventral keel that is seen in *T. coccinarum* scutes, are only twice as wide as long, and the lateral scutes of *D. chamaensis* have an obtuse angle of curvature. Scutes and other fossils of *D. chamaensis* from the Snyder quarry are also briefly described separately in this volume (Heckert et al., 2003).

RAUISUCHIA von Huene, 1942

RAUISUCHIDAE von Huene, 1942

***Postosuchus* Chatterjee, 1985**

Rauisuchians, presumably *Postosuchus*, are represented by two femora, one a very large complete adult specimen (NMMNH P-36144) and the other an incomplete juvenile specimen (NMMNH P-33131) (Fig. 10). The large, presumably adult femur recovered from the Snyder quarry is anteroposteriorly crushed, which causes it to be thinner than normal (Fig. 10A-B). It is a slender and relatively gracile bone that is 374 mm long (proximal-distal), 104 mm mediolaterally at the proximal end, 48 mm mediolaterally at midshaft and 105 mm mediolaterally at the distal end. The greater trochanter is large and projects on the anterolateral face of the proximal end as a ridge that is triangular in cross-section. A wide, very shallow groove separates it from the lateral edge of the proximal head. The anterior margin of the proximal end is moderately concave. The medial side expands into the greater trochanter, whereas the lateral side is quite thin. The top of the proximal head is concave and anteroposteriorly grooved. There are no clear epiphyses, as there are in phytosaur femora. There is a very slight torsion to the shaft, but it is not nearly as twisted or sigmoidal as in phytosaurs. The fourth trochanter is mildly developed and located in the upper third of the posterior side of the femur. It is represented by a long, rugose ridge.

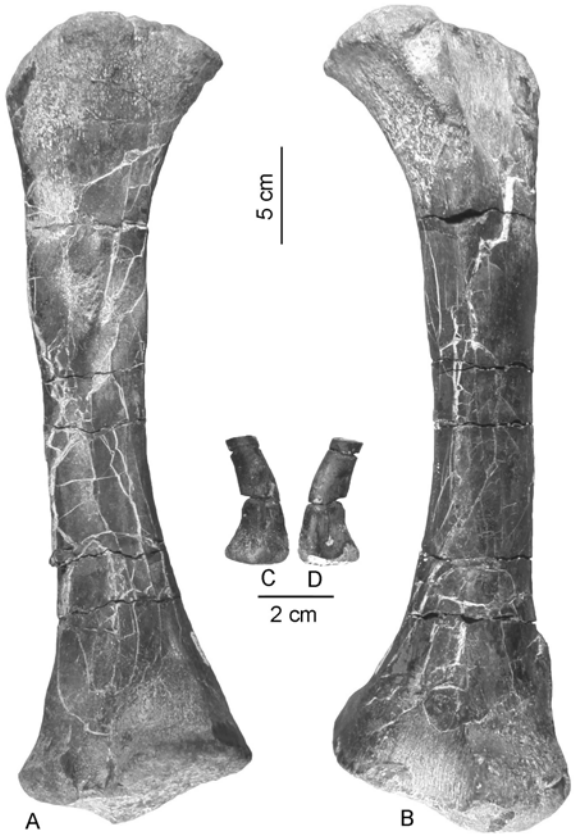

FIGURE 10. Rauisuchian fossils from the Snyder quarry. **A-B.** NMMNH P-36144, right adult femur in **A,** anterior and **B,** posterior views. **C-D.** NMMNH P-33131, distal left juvenile femur in **C,** anterior and **D,** posterior views.

The distal end of the femur is wider (anteroposteriorly) than it is long. The condyles are separated by a moderately wide and deep cleft. The lateral condyle has two parts: the more posterior one is smaller and knoblike, whereas the anterior one is larger and ovoid in outline. They are separated by a concavity on the distal articular surface and by a wide, shallow groove on the lateral side. The medial condyle is larger than both lateral condyles combined and is gently convex. On the anterior side of the bone, a very gentle, wide cleft separates the distal condyles. The anterior lateral condyle projects farther anteriorly than does the medial condyle. The lateral side of the bone is thinner than the medial side, which is more rounded. Unfortunately, the shaft of the specimen was too badly crushed for any other features to be discernable.

The juvenile specimen (P-33131) is only the distal half of a right femur (Fig. 10C,D). This specimen is much smaller (only 32 mm long and 15 mm wide at the distal end, as preserved), but the distal end is otherwise similar to that of the larger specimen.

These specimens are tentatively referred to the rauisuchian *Postosuchus* because of the similarity of these femora to illustrated and described specimens of *Postosuchus* (*sensu stricto*) (e.g. Long and Murry, 1995). Similarities include the well developed femoral head, the strongly concave anterior margin of the proximal head, the posterior margin exhibiting two separated processes, a well developed greater trochanter, and the distal end being much wider than long, with lateral and medial condyles separated by a moderately deep groove (Long and Murry, 1995).

FIGURE 11. NMMNH P-30772, a sphenosuchian scute from the Snyder quarry.

CROCODYLOMORPHA Walker, 1968

SPHENOSUCHIA Hoffstetter, 1955

Sphenosuchia indet.

A single, oddly-shaped scute with a distinct dorsal prong (NMMNH P-30772) is referable to Sphenosuchia (Fig. 11). This scute is nearly complete and is 22 mm anteroposteriorly, 7 mm mediolaterally, and the prong is 4 mm long. The scute body is subrectangular and moderately convex, with the prong projecting from the lateral side of the posterior margin. The prong itself is straight, cylindrical and pointed. The dorsal surface of the scute has a prominent ridge running anteroposteriorly from the inside of the prong to the anterior scute edge. There are two rows of tiny round pits, one on each side of the base of the dorsal ridge. Faint subparallel grooves run mediolaterally from the dorsal ridge to the medial margin of the scute body. The lateral edge has fine, sub-millimeter, closely spaced spines that end where the prong begins. The medial edge may also have spines, but they are not preserved. The anterior margin is broken, but is probably a rounded edge. The lateral edge arcs medially to join the anterior margin so that the anterior margin is much narrower than the posterior margin. We refer this specimen to Sphenosuchia because of the presence of the posteriorly-oriented prong on the posterior margin of the scute body. It is not referable to the enigmatic reptile *Vancleavea* because the scute body is too elongate (Long and Murry, 1995; Hunt et al., 2002) and is too narrow to be referable to *Hesperosuchus* (Long and Murry, 1995).

CERATOSAURIA Marsh, 1884

COELOPHYSOIDEA Nopsca, 1928

COELOPHYSIDAE Nopsca, 1928

***Eucoelophysis* Sullivan and Lucas, 1999**

Numerous fossils pertaining to the theropod dinosaur *Eucoelophysis* have been recovered from the Snyder quarry (Heckert et al., 2000; Zeigler et al., 2000, 2002a,b; Zeigler, 2002). There are potentially two different taxa present based upon striking differences in bone sizes, with one taxon being much larger than the other (Heckert et al., 2000). The majority of the recovered material pertains to the smaller taxon and includes a partial skull, lower jaws and articulated cervical vertebrae, among other elements. Three tibiae of the smaller taxon constrain the MNI. These tibiae all possess the appressed surface diagnostic of *Eucoelophysis* (Sullivan and Lucas, 1999) All of the theropod limb bones are hollow with a thick calcite infilling, and the bone walls are comparatively thin. Features that support assigning this material to Ceratosauria and to Coelophysoidea include the presence of a subnarial gap in the skull, a heterodont premaxilla, and gracile limb bones (Heckert et al., 2000). The smaller taxon is more similar to *Eucoelophysis* than to *Megapnosaurus* (=*Syntarsus*), whereas the larger taxon is too fragmentary to identify more precisely. The presence of theropod material in the Snyder quarry is important because of the relative rarity of Chinle dinosaurs. The Snyder quarry theropod material is discussed further in Heckert et al. (2003b).

DISCUSSION

The preceding descriptions serve to accentuate how diverse the fauna of the Snyder quarry is. The vertebrate fossils recovered cover a wide range of taxa and of modes of life, ranging from sharks and bony fish to small reptiles to mammal-like reptiles to large archosaurs to some of the earliest dinosaurs. It is not unexpected, however, to see such a high diversity of animals, given the catastrophic nature of the assemblage. Catastrophic assemblages, such as the Snyder quarry, preserve a much more complete picture of an ecosystem than do attritional deposits. It is assemblages such as this that alert us to the presence of less common taxa that we would otherwise be completely unaware of, and allows us to flesh out the fossil record in greater detail.

The taxa that we have listed here cover a wide range of habitats. The aquatic realm is represented by a variety of fish, including redfieldiids, semionotids, coelacanths and possible xenacanths, as well as by the large metoposaurid amphibian *Buettneria*. The transitional semi-aquatic environment is represented by the phytosaur *Pseudopalatus buceros*, which dominates the assemblage numerically. There are more terrestrial organisms than aquatic or semi-aquatic animals, and these range from the large, herbivorous aetosaurs *Typothorax coccinarum* and *Desmatosuchus* and the large carnivorous rauisuchian *Postosuchus* to the diminutive procolophonid, lepidosauromorph, sphenosuchian and cynodont. This wide variety of terrestrial animals speaks to the diversity of the Late Triassic terrestrial ecosystem, as well as emphasizing the potential impacts of a wildfire on these animals.

The presence of rarer taxa, such as the cynodont, has also allowed us to note at least two important age-range extensions. The large metoposaurid *Buettneria* is very rare in rocks of Revuletian age. The presence of this large amphibian in the Snyder quarry makes this among the youngest occurrences of *Buettneria*. Also, as discussed previously, if the cynodont is indeed referable to Tritylodontidae, then this is the oldest occurrence of a tritylodont by about 15 my.

Thus, the Snyder quarry preserves a unique and exciting array of vertebrate fossil material. With continued preparation of material from the quarry, we anticipate adding further information to this already diverse faunal list.

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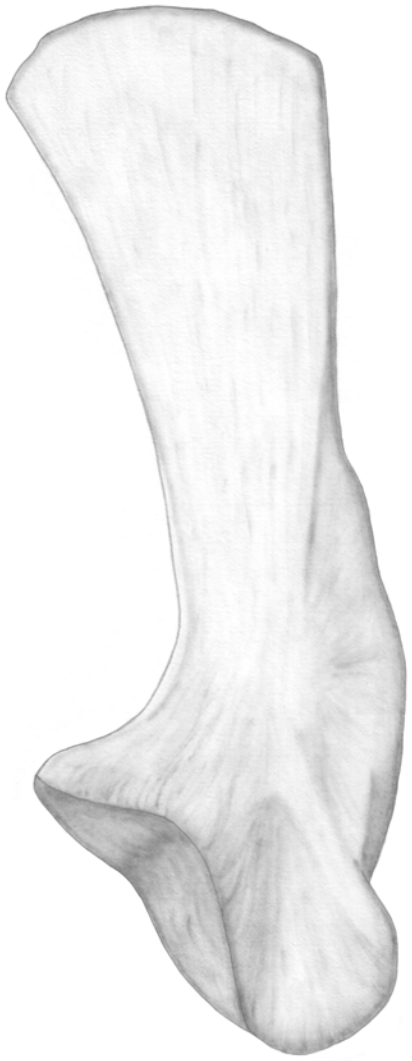

NMMNH P-35998, left scapula of the phytosaur *Pseudopalatus buceros* from the Snyder quarry (illustration by K.E. Zeigler).